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Short- and long-term outcomes of ST-segment elevation myocardial infarction treated with CABG: a population-based cohort study

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ABSTRACT

Objectives To investigate the outcomes of patients with ST-elevation myocardial infarction (STEMI) who were treated with coronary artery bypass grafting (CABG) surgery.

Design Retrospective nationwide cohort study.

Setting Patients with STEMI in Finland who were treated with CABG between January 2004 and December 2018.

Participants 1069 patients (mean age: 66.4, 21.4% women).

Primary outcome measure All-cause mortality (median follow-up 6.4 years) and usage of evidence-based secondary preventive medication early after CABG.

Results In-hospital mortality among the total cohort was 10.0%, with a significant decrease (p<0.0001) during the study period. Cumulative 10-year mortality was 38.3%. Age, diabetes, renal disease, early surgery, usage of only venous grafts and concomitant procedures were associated with in-hospital mortality in multivariable modelling. Age, cerebrovascular disease, diabetes, heart failure, peripheral vascular disease, rheumatic disease and venous-only grafts were associated with 10-year mortality. Statins and beta blockers were used by >90% of patients and ACE inhibitors/angiotensin II receptor blockers by 70% of patients after discharge from the hospital. The proportion of high-dose statin users increased from 33.1% in 2004–2008 to 63.1% in 2014–2018. ADP inhibitors were used by 29.0% of patients, but the proportion increased during the study.

Conclusions Contemporary in-hospital and long-term outcomes of CABG-treated patients with STEMI are acceptable. In-hospital mortality has decreased, and the usage of secondary prevention medications after CABG procedures has increased in recent years.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The main strength of the study is the nationwide all-comers data with a very long and complete follow-up.
⇒ The main limitations are a lack of granular data on patient-level specifics such as procedural details and physiological measurements.

INTRODUCTION

The primary treatment for patients with ST-segment elevation myocardial infarction (STEMI) is percutaneous coronary intervention (PCI). Nevertheless, 5%–10%[1–3] of patients with STEMI are treated with emergent or urgent coronary artery bypass grafting (CABG) surgery. The European Society of Cardiology (ESC) guidelines on coronary revascularisation recommend contemplating complete revascularisation for stable or stabilised acute coronary syndromes, and consequently, coronary bypass surgery is required when there is, for example, three-vessel disease in a patient in need of complete revascularisation after culprit PCI. Additionally, when there is ongoing myocardial ischaemia that cannot be adequately treated with PCI or there are complications from PCI, bypass surgery should be considered.[4 5] Evidence suggests that complete early revascularisation is beneficial, but the optimal timing of staged approaches is unclear and less data exist on the role of CABG in STEMI as it is seldom treated surgically. Large-scale data on the outcomes and secondary preventive medications used by these patients are lacking. Thus, we aimed to study outcomes in the population of patients who were treated with surgical coronary revascularisation for STEMI in a nationwide cohort.

METHODS

Study patients and design

Finland has a centralised healthcare system available to all citizens at a low cost. All patients aged ≥18 who suffered STEMI treated with CABG in Finland from 1 January 2004 to 31 December 2018 registered in the Care Register for Healthcare (CRHC) were retrospectively included in this study. This nationwide, mandatory bylaw register governed by the National Institute for Health and Welfare

of Finland collects information on all hospital admissions in Finland. Bypass surgery for STEMI was performed in six hospitals, all of which were included in the study. Patient features and usage of cardiovascular medication after discharge were studied. The outcomes of interest were in-hospital and 10-year mortality. The follow-up ended by December 2020, and the median follow-up period was 6.4 years (IQR 3.4–10.0).

Patient and public involvement statement

None.

Definitions

Patients with MI were recognised through ICD-10 code I21 as the primary diagnosis. STEMI was recognised through ICD-10 codes I21.0–I21.3. Ward and hospital transfers were combined as one admission period. Procedures were recognised using the Nordic Classification of Surgical Procedures coding in the CRHC.[6] Patients with missing follow-up data (0.9%) were excluded (online supplemental figure 1). Comorbidities were recognised from the combination of CRHC, the Finnish Cancer Registry and the Nationwide database of permissions for drug reimbursements in Finland, as previously described.[7] Secondary preventive medication purchases were recognised from the drug purchase database of the Social Insurance Institution of Finland with applicable Anatomical Therapeutical Chemical classification (ATC) coding. This database collects purchases of all prescription medications in Finland. Cardiovascular medications (except aspirin) are only available by prescription in Finland. Studied medications are reimbursed by the state and dispersed from the pharmacy for a maximum period of 3 months.[8] Prescription medication use before MI was defined as a drug purchase within 90 days prior to the index event and medication use after MI as a drug purchase within 90 days after hospital discharge. The intensity of statin therapy was classified based on statin and the first purchase dose after discharge (online supplemental table 1). Mortality data up to 31 December 2020 were obtained from the Statistics Finland database with full population coverage. Included registries are mandatory by law and fully cover the Finnish population. This was a retrospective register study, and thus informed consent was waived, as the participants were not contacted. The legal basis for the processing of personal data in this article is public interest and scientific research (EU General Data Protection Regulation 2016/679 (GDPR), Article 6 (1)(e) and Article 9 (2)(j); Data Protection Act, Sections 4 and 6).

Statistical analyses

Differences between groups were studied using t-tests, χ^2 tests or Fisher's exact tests. In-hospital mortality was studied using a modified robust Poisson regression. The 10-year mortality rate was studied with Cox regression. Schoenfeld residuals were used to confirm the proportional hazard assumptions. Multivariable regression models included age, sex and variables associated with outcome at p<0.1 in univariate analysis. The results are given as the mean, median, percentage, HR or risk ratio with a 95% CI or SD. A p value <0.05 was considered statistically significant. Analyses were performed with SAS V.9.4 (SAS Institute, Cary, North Carolina, USA).

RESULTS

The study included 1069 patients. Baseline features are presented in table 1. The mean age of all patients was 66.4 years (SD: 9.8, range 35–88 years). Women (21.4% of the study patients) were older and had a higher prevalence of diabetes and heart failure. Peripheral vascular disease was more common in men. Usage of cardiovascular medication before STEMI is described in online supplemental table 2. Surgery was performed within 48 hours for 49% of the patients, and 85% of the patients underwent CABG within 7 days. Only venous bypass grafting was used in 16% of the patients. Women were more often treated with venous-only grafts and with fewer anastomoses. Concomitant operations were performed on 7% of the patients, most commonly for mitral valve defects.

In-hospital mortality during the entire study period was 10.0%. The short-term prognosis of patients with STEMI who were operated on improved significantly during the study period (table 2). In-hospital mortality was 17.2% from 2004 to 2008, 7.8% from 2009 to 2013 and 7.6% from 2014 to 2018 (p<0.0001). Advanced age, diabetes, renal disease, surgery within 48 hours, usage of venous-only grafts and concomitant procedures were associated with in-hospital mortality in the multivariable model (table 2).

Cumulative 10-year mortality was 38.3% (figure 1). Baseline age, cerebrovascular disease, diabetes, heart failure, peripheral vascular disease, rheumatic disease and renal disease, in addition to early surgery and use of venous-only grafts, were associated with long-term mortality in multivariable modelling (table 3). Sex or number of grafted anastomoses was not independently associated with mortality.

The usage of secondary preventive postdischarge medication is described in table 4. ADP inhibitors were used by only 29.3% of patients overall, but the proportion increased during the study. ACE inhibitor or angiotensin receptor blocker (ARB) was used by 70.3% of patients and beta blocker by 94.1% of patients with no change during the study. The proportion of patients who used statin remained similar during the study (90.6% in total), but statin therapy was notably intensified during the study period (table 4). There were no significant differences in usage of secondary preventive medications postoperation between men and women, except for mineralocorticoid receptor antagonists (MRAs), which were more frequent in women (online supplemental table 3).

Table 1 Baseline features of patients with STEMI who were treated with CABG

Variable	All patients n=1069	Men n=840	Women n=229	P value
Age, years (SD)	66.4 (9.8)	65.2 (9.6)	70.8 (9.2)	<0.0001
Location of STEMI				0.048
Anterior	530 (49.6%)	401 (47.7%)	129 (56.3%)	
Inferior	371 (34.7%)	306 (36.4%)	65 (28.4%)	
Lateral/NS	168 (15.7%)	133 (15.8%)	35 (15.3%)	
Comorbidities				
Atrial fibrillation	89 (8.3%)	69 (8.2%)	20 (8.7%)	0.801
Cerebrovascular disease	94 (8.8%)	73 (8.7%)	21 (9.2%)	0.820
Chronic pulmonary disease	91 (8.5%)	70 (8.3%)	21 (9.2%)	0.688
Diabetes	235 (22.0%)	170 (20.2%)	65 (28.4%)	0.008
Heart failure	159 (14.9%)	110 (13.1%)	49 (21.4%)	0.002
Malignancy	91 (8.5%)	73 (8.7%)	18 (7.9%)	0.530
Peripheral vascular disease	84 (7.9%)	77 (9.2%)	7 (8.3%)	0.002
Prior myocardial infarction	225 (21.1%)	175 (20.8%)	50 (21.8%)	0.742
Rheumatic disease	35 (3.3%)	24 (2.9%)	11 (4.8%)	0.142
Renal failure	24 (2.3%)	19 (2.3%)	5 (2.2%)	0.943
Surgery within ≤48 hours	520 (48.6%)	412 (49.1%)	108 (47.2%)	0.613
Type of bypass grafts				0.024
Arterial and venous	771 (72.1%)	621 (73.9%)	150 (65.5%)	
Arterial only	123 (11.5%)	94 (11.2%)	29 (12.7%)	
Venous only	175 (16.4%)	125 (14.9%)	50 (21.8%)	
Number of grafted anastomoses***				0.001
1	109 (10.2%)	76 (9.1%)	33 (14.4%)	
2	143 (13.4%)	107 (12.7%)	36 (15.7%)	
3	343 (32.1%)	261 (31.1%)	82 (35.8%)	
4	292 (27.3%)	236 (28.1%)	56 (24.5%)	
≥5	182 (17.0%)	160 (19.1%)	22 (9.6%)	
Concomitant procedure	75 (7.0%)	55 (6.6%)	20 (8.7%)	0.251
Left ventricle	6 (0.6%)	5 (0.6%)	1 (0.4%)	1.000*
Mitral valve	38 (3.6%)	28 (3.3%)	10 (4.4%)	0.454
Aortic valve	22 (2.1%)	14 (1.7%)	8 (3.5%)	0.111*
Tricuspid valve	4 (0.4%)	3 (0.4%)	1 (0.4%)	1.000*
Aorta	8 (0.8%)	7 (0.8%)	1 (0.4%)	1.000*
PCI during admission	20.2%	20.5%	19.2%	0.673
Operation year				0.307
2004–2008	273 (25.5%)	206 (24.5%)	67 (29.3%)	
2009–2013	412 (38.5%)	331 (39.4%)	81 (35.4%)	
2014–2018	384 (35.9%)	303 (36.1%)	81 (35.4%)	

*Fisher's exact test.
CABG, coronary artery bypass grafting; PCI, percutaneous coronary intervention; STEMI, ST-elevation myocardial infarction.

DISCUSSION

In our nationwide multicentre cohort study of CABG-treated patients with STEMI, the overall in-hospital mortality rate was 10%, and cumulative 10-year mortality was 38.8%. The in-hospital and midterm results found here are in line with the existing literature. Head *et al*[9] conducted a systematic review to identify randomised clinical trials that compared CABG to

Table 2 Association of baseline features with in-hospital mortality of patients with STEMI who were treated with CABG

Association between baseline features and in-hospital mortality				
	Univariable		Multivariable	
Variable	RR (95% CI)	P value	RR (95% CI)	P value
Age (per 10-year increment)	1.58 (1.29–1.94)	<0.0001	1.34 (1.07–1.67)	0.011
Female sex	1.68 (1.15–2.46)	0.010	1.20 (0.81–1.78)	0.355
Location of STEMI		0.371	–	
Comorbidities			–	
Atrial fibrillation	1.78 (1.08–2.93)	0.024	1.36 (0.79–2.35)	0.266
Cerebrovascular disease	1.18 (0.65–2.11)	0.588	–	
Chronic pulmonary disease	1.34 (0.77–2.35)	0.302	–	
Diabetes	1.93 (1.33–2.78)	0.001	1.68 (1.17–2.41)	0.005
Heart failure	2.41 (1.63–3.51)	<0.0001	1.18 (1.00–2.28)	0.050
Malignancy	1.34 (0.77–2.35)	0.302	–	
Peripheral vascular disease	1.60 (0.94–2.74)	0.083	–	
Prior myocardial infarction	1.13 (0.74–1.72)	0.571	–	
Rheumatic disease	1.74 (0.82–3.68)	0.149	–	
Renal disease	3.48 (1.92–6.32)	<0.0001	2.17 (1.06–4.45)	0.034
Surgery within ≤48 hours	2.62 (1.76–3.91)	<0.0001	2.36 (1.62–3.44)	<0.0001
Type of bypass graft		<0.0001		<0.0001
Arterial and venous	Reference		Reference	
Arterial only	2.23 (1.30–3.82)	0.004	1.72 (0.90–3.31)	0.102
Venous only	4.60 (3.16–6.69)	<0.0001	3.45 (2.26–5.27)	<0.0001
Number of grafted anastomoses		0.041		0.579
1	Reference		Reference	
2	0.44 (0.22–0.85)	0.014	0.63 (0.31–1.28)	0.199
3	0.50 (0.30–0.85)	0.007	0.98 (0.53–1.82)	0.950
4	0.43 (0.25–0.73)	0.002	0.92 (0.46–1.82)	0.807
≥5	0.51 (0.29–0.92)	0.025	1.02 (0.52–2.02)	0.945
Concomitant procedure	2.48 (1.56–3.93)	0.0001	1.78 (1.09–2.90)	0.021
PCI	0.96 (0.61–1.50)	0.836	–	–
Operation year		<0.0001		<0.0001
2004–2008	Reference		Reference	
2009–2013	0.45 (0.30–0.69)	0.0002	0.42 (0.28–0.63)	<0.0001
2014–2018	0.44 (0.28–0.68)	0.0002	0.36 (0.23–0.56)	<0.0001

CABG, coronary artery bypass grafting; PCI, percutaneous coronary intervention; RR, risk ratio; STEMI, ST-elevation myocardial infarction.

PCI and stenting in hemodynamically stable patients. They found that the 5-year all-cause mortality was 11.2% after PCI and 9.2% after CABG.

In this study, 49% of patients underwent CABG within 2 days of hospital admission. This reflects the urgency of the situations and the severity of MIs. CABG within 2 days was associated with increased in-hospital mortality. Lemaire *et al*[10] studied patients with STEMI who were treated with CABG within 7 days and divided them into three groups according to the timing of the operation. In-hospital mortality was higher in group A (within 24 hours, 8.2%) compared with group B (second to third day, 3.5%) and group C (fourth to seventh day, 2.9%, p<0.0001 for both). In the contemporary literature, in-hospital mortality for PCI-treated STEMI is 5%–10%[11–13] and long-term survival (3–5 years) is 75%–87%,[13 14] which is comparable to the results from this study and other surgical cohorts. However, previous studies on the long-term outcomes of CABG-treated STEMI are lacking.

In one single-centre study by Grothusen *et al*,[15] the 10-year survival rate for stable patients with STEMI who were treated with CABG was 74%. However, direct comparisons between CABG and PCI should be made

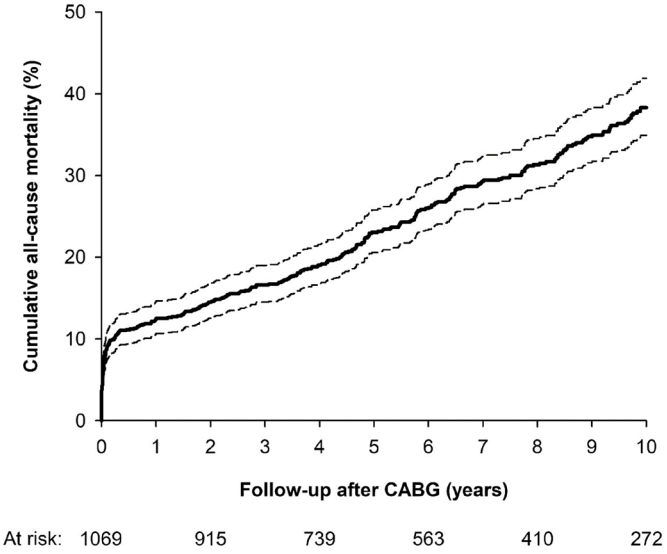

Figure 1 Cumulative mortality of patients with STEMI who were treated with CABG. The dashed lines represent 95% CIs. Scale 850×667. CABG, coronary artery bypass grafting surgery; STEMI, ST-elevation myocardial infarction.

with caution due to potential selection bias. Most patients with STEMI can be treated with percutaneous techniques. Emergent or urgent CABG is seldom required, but when it is needed, the situation is often complicated. However, the most severely hemodynamically compromised patients and those with prohibitive surgical risks due to extensive comorbidities are treated with high-risk PCI.

STEMI increases mortality per se, as reflected by the previously described 70%–80% 10-year survival rate after CABG in general.[16] Luckily, the short-term prognosis of the CABG-treated patients with STEMI improved during the present study. This trend has also been seen in the literature.[11 17] The improved outcomes described in the present study partly reflect the evolution of CABG procedures and preoperative care, as seen in other studies on surgical revascularisation,[11 18] but it is also highly likely that the evolving outcomes represent a learning curve in patient selection.

Lack of adherence to guideline-recommended secondary medication[19 20] is a well-known challenge in cardiovascular medicine, especially after surgical revascularisation.[21] Somewhat surprisingly, we found statins to be used by >90% of patients after CABG-treated STEMI. It has been well established that patients with acute coronary syndrome (ACS) benefit from intensive statins. Cannon *et al*[22] (PROVE IT-TIMI) studied patients with ACS treated with 40 mg pravastatin/daily versus 80 mg atorvastatin/daily. In the atorvastatin group, the risk of death, MI and urgent revascularisation were reduced by 25%, suggesting the need for lower low-density lipoprotein (LDL) cholesterol levels. During the IDEAL study,[23] randomised patients received either high-dose atorvastatin (80 mg/day) or simvastatin (20 mg/day). Intensive lowering of LDL cholesterol levels was insignificant in risk reduction in the primary outcomes of major coronary events but did reduce the risk of other secondary endpoints and non-fatal acute MI. A recent large nationwide study in Finland found more intense initial statin treatment to predict better outcomes after MI.[24] We found that the proportion of high-dose statin users increased from 33.1% in 2004–2008 to 63.1% in 2014–2018.

Beta blockers are recommended during and after STEMI to prevent post-MI arrhythmias and to lower the risk of mortality, especially in patients with lower left ventricular ejection fraction (LVEF), although the majority of beta blocker studies are from an era before revascularisation.[19 20 25] In our study, the early adherence to beta blockers was 94%. Ferreira *et al*[26] found beta blockers to be beneficial in patients with reduced LVEF presenting a better prognosis compared with non-beta blocker users. Allonen *et al*[27] found poor adherence to beta blockers to be associated with increased long-term mortality among patients with ACS. Even low-risk patients seemed to benefit from beta blockers.

In the outpatient population, only 29% were taking ADP inhibitors postdischarge during the whole study period, which is surprisingly low considering current STEMI guidelines.[5 19 28] However, its usage increased significantly during the follow-up period from 17% to 40%. One explanation for the low use of ADP inhibitors is the lack of dedicated studies on surgical patients. Scientific evidence of ADP inhibitor in patients with MI treated with CABG is currently based on subgroup analyses of larger trials, such as the CURE trial.[29] However, this is an ongoing prospective randomised trial (TACSI trial, ClinicalTrials.gov identifier: NCT03560310) aimed at defining the role of dual antiplatelet therapy with acetylsalicylic acid (ASA) or dual antiplatelet therapy with ASA and ticagrelor during surgical coronary revascularisation in patients with acute coronary syndrome.

ACE inhibitor or ARB were used by 70.3% of the patients in our data. ACE inhibitor (and ARB if the former was not tolerated) is recommended in current guidelines for treatment after MI, but also after CABG for patients with LV dysfunction or heart failure, diabetes mellitus, hypertension and chronic kidney disease.[19 25] In a study by Pfeffer *et al*,[30] which compared valsartan to capropril, valsartan was found to be more effective than captopril.[30] MRA was used by 7.1% of our study population, with the proportion increasing over time. MRA is recommended in current guidelines for patients with LV dysfunction (LV <40 %) and heart failure after STEMI.[25] Recorded heart failure was found in 15% of our study population. Women experienced heart failure significantly more often and used MRA more often.

Limitations

This was a retrospective register study with associated limitations. The used registries are mandated by law and have full population coverage. However, coding errors could have been possible. We did not have access to more detailed operation or clinical information such as the use

Table 3 Association of baseline features with 10-year mortality of patients with STEMI who were treated with CABG

Association between baseline features and 10-year mortality				
	Univariable		Multivariable	
Variable	HR (95% CI)	P value	HR (95% CI)	P value
Age (per 10-year increment)	1.59 (1.42–1.80)	<0.0001	1.41 (1.24–1.60)	<0.0001
Female sex	0.82 (0.63–1.05)	0.111	0.94 (0.72–1.23)	0.640
Location of STEMI		0.138	–	
Comorbidities			–	
Atrial fibrillation	1.88 (1.34–2.62)	0.0002	1.16 (0.82–1.65)	0.402
Cerebrovascular disease	1.72 (1.25–2.38)	0.001	1.57 (1.12–2.19)	0.008
Chronic pulmonary disease	1.50 (1.07–2.12)	0.019	1.28 (0.90–1.82)	0.178
Diabetes	2.00 (1.58–2.52)	<0.0001	1.81 (1.41–2.30)	<0.0001
Heart failure	2.46 (1.92–3.14)	<0.0001	1.77 (1.35–2.31)	<0.0001
Malignancy	1.63 (1.16–2.31)	0.006	1.14 (0.79–1.64)	0.489
Peripheral vascular disease	2.69 (1.98–3.66)	<0.0001	1.68 (1.21–2.34)	0.002
Prior myocardial infarction	1.23 (0.96–1.58)	0.106	–	
Rheumatic disease	1.58 (0.93–2.70)	0.094	1.80 (1.04–3.14)	0.037
Renal disease	3.75 (2.28–6.12)	<0.0001	2.34 (1.37–3.99)	0.002
Surgery within ≤48 hour	1.42 (1.14–1.76)	0.002	1.29 (1.03–1.62)	0.026
Type of bypass graft		<0.0001		<0.0001
Arterial and venous	Reference		Reference	
Arterial only	1.06 (0.74–1.53)	0.748	0.88 (0.52–1.47)	0.622
Venous only	3.04 (2.38–3.89)	<0.0001	2.39 (1.80–3.18)	<0.0001
Number of grafted anastomoses		0.052		0.082
1	Reference		Reference	
2	0.59 (0.39–0.91)	0.015	0.54 (0.32–0.90)	0.017
3	0.71 (0.50–1.01)	0.056	0.69 (0.43–1.12)	0.130
4	0.59 (0.41–0.86)	0.005	0.59 (0.35–0.97)	0.039
≥5	0.76 (0.52–1.12)	0.160	0.77 (0.45–1.31)	0.328
Concomitant procedure	1.98 (1.39–2.81)	0.0001	1.42 (0.97–2.07)	0.069
PCI	0.88 (0.66–1.18)	0.393	–	–

CABG, coronary artery bypass grafting; PCI, percutaneous coronary intervention; STEMI, ST-elevation myocardial infarction.

of thrombolysis or on social determinants of health such as employment status or education. Our cohort is a real-life representation of patients with STEMI treated with CABG, but we did not have exact information as to why CABG was chosen over PCI. We were unable to study the usage of aspirin, since it is available without prescription in Finland. Based on clinical experience, aspirin is used by virtually all non-anticoagulated patients with STEMI. The use of mechanical circulatory support (MCS) such as IABP or ECMO could not be ascertained due to lack of granular data. The exact type of device and cannulation cannot be deduced from the NOMESCO codes nor is it possible to know whether or not the inserted circulatory assist modality was actually used or just inserted pre-emptively nor was the implantation preoperative, intraoperative or postoperative. It is also not possible to quantify the actual duration or intensity of the circulatory assistance. The percentage of patients receiving MCS, however, has been reported to be about 20.2% of patients undergoing CABG for AMI during the same hospital admission in the USA between 2000 and 2017 with numbers remaining consistent during the period, while ECMO was used in under 0.5%.[31] In Nordic countries, the use of MCS is less common, for example, unpublished administrative data from our own centre (Turku University Hospital, Turku, Finland) show that in all patients undergoing isolated CABG between 2020 and 2024, ECMO was used in 0.3% of patients and IABP in 0,5%. In a Nordic multicentre study of patients undergoing emergency or salvage CABG between 2006 and 2013 (defined as an operation performed before the beginning of the next working day), IABP was used in 21% and ECMO in 2%.[32] These patients were, however, all unstable and 6% underwent cardiopulmonary resuscitation (CPR) on

Table 4 Usage of postdischarge secondary preventive medication in hospital-surviving patients with STEMI who were treated with CABG during the study period

	Postoperative medication				
	Total	2004–2008	2009–2013	2014–2018	
	n=961	n=226	n=380	n=355	P value
ADP inhibitor	279 (29.0%)	38 (16.8%)	100 (26.3%)	141 (39.7%)	<0.0001
Anticoagulant	237 (24.7%)	52 (23.0%)	84 (22.1%)	101 (28.5%)	0.110
ACE inhibitor or ARB	676 (70.3%)	163 (72.1%)	255 (67.1%)	258 (72.7%)	0.204
Beta blocker	904 (94.1%)	215 (95.1%)	356 (93.7%)	333 (93.8%)	0.739
Ezetimibe	25 (2.6%)	3 (1.3%)	7 (1.8%)	15 (4.2%)	0.050
MRA	68 (7.1%)	13 (5.8%)	20 (5.3%)	35 (9.9%)	0.035
Statin	871 (90.6%)	208 (92.0%)	335 (88.2%)	328 (92.4%)	0.102
Statin intensity*					<0.0001
Low	18 (2.1%)	9 (4.3%)	8 (2.4%)	1 (0.3%)	
Moderate	565 (64.9%)	183 (88.0%)	262 (78.2%)	120 (36.6%)	
High	288 (33.1%)	16 (7.7%)	65 (19.4%)	207 (63.1%)	

P value is for comparison between eras.
*Of statin users.
ARB, angiotensin receptor blocker; CABG, coronary artery bypass grafting; MRA, mineralocorticoid receptor antagonist; STEMI, ST-elevation myocardial infarction.

route to the theatre.[32] The percentage of MCS patients in the current study is arguably much lower as the population includes also all stable and/or stabilised patients with STEMI. Also as the existing evidence base for the indication, timing and benefit of ECMO and IABP in postcardiotomy syndrome are not unequivocal and taking all these confounders into consideration adjusting the statistical models for MCS would not yield any additional clarity. Prospective studies are needed to yield more detailed data on these patients.

CONCLUSION

This cohort study provides evidence that short- and long-term mortalities for CABG-treated patients with STEMI are improving with time as well as are acceptable and comparable to contemporary outcomes after PCI for STEMI. While these results also encourage the consideration of surgical revascularisation in the treatment of STEMI, the results are more than likely to have been affected by careful patient selection, but this cannot be detected from the registry data. Despite favourable outcomes, there is still room for improvement in the usage of secondary preventive medication after CABG-treated STEMI, especially for ADP inhibitors and high-dose statins.

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